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Advances in Electrometer Vacuum Tube Design

Electrometers have been used in industrial and laboratory applications for detecting very low signals in the pico-volt (10^{-12}) range. In the past, the vacuum tubes used to drive these devices required more current than desirable and were subject to damage and failure through shock and vibration. As a result, design advances in both the construction and performance of these tubes have been required.

A single-ended, miniature-cathode tube with a relatively low grid current level was constructed. Adequate cathode temperature at relatively low heater power drain is provided by designing the supporting spacers to provide a square cathode hole. By mounting a round cathode in a square hole, the four-point contact between cathode and spacers combines minimum cathode cooling with rugged construction. High insulation resistance between tube elements is achieved by coating the spacers with a coarse-grained fused aluminum oxide.

This tube exhibits very stable performance and operates with a grid current level below 3.0×10^{-14} amps. Samples exposed to temperatures of 150°C for 100 hours showed little change in characteristics, making the tube applicable to future low energy radiation investigations where thermal sterilization of the tube is probable.

To achieve a satisfactory metal-ceramic filamentary subminiature electrometer tube, a leak-tight subminiature ceramic stem (insulator) assembly was fabricated. The ceramic stem, made of 96% alumina, was metalized with lithium-molybdate followed by nickel plating. The metalized and plated ceramic-nickel leads and

nickel sealing ring were then brazed together into a leak-tight assembly.

Assembling the mount and bonding the tube elements and a metal sealing ring to a top ceramic spacer without damaging the filament was accomplished by the following method. The metal sealing ring used at the top of the mount was modified by the addition of a window to allow the entrance of a welding tip so that the top filament could be welded after the sealing ring and unit were bonded together. The filament was added and the unit was attached to the stem assembly with flexible leads. This assembly was inserted into the nickel sleeve that forms the metal envelope and was heliarc-welded at the top and bottom of the mount assembly.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.65)

Reference:

NASA-CR-96797 (N70-75458), Advanced
Electrometer Vacuum Tubes

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